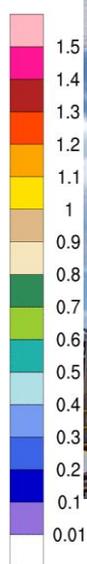
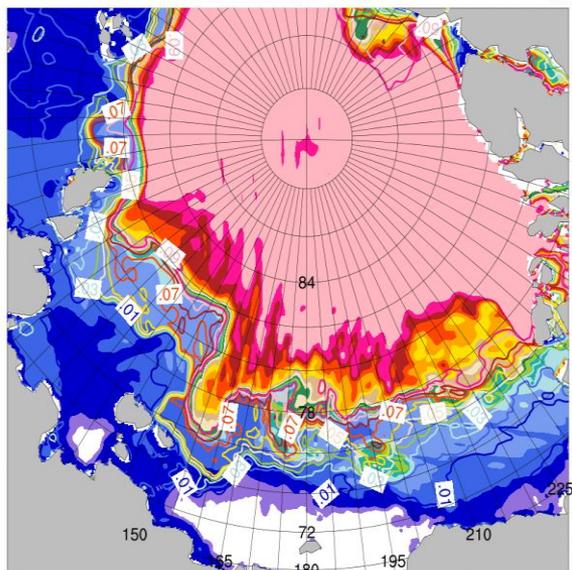


MOSAiC Session



ice and snow thickness day 5 m



Agenda

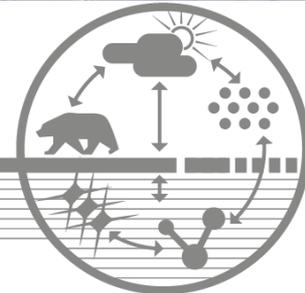
- 1) Overview-Update: Matthew Shupe
- 2) ARM Installations for MOSAiC: Heath Powers
- 3) Aerosol ice nucleation and mixing state: Jessie Creamean, Brent Christner, Amy Solomon, Kerri Pratt
- 4) Enhanced surface fluxes: Matthew Shupe
- 5) Coupled-system forecasting and modeling: Amy Solomon
- 6) Thoughts on modeling for MOSAiC: Mikhail Ovchinnikov
- 7) Targeted discussion

Multidisciplinary drifting Observatory for the Study of Arctic Climate

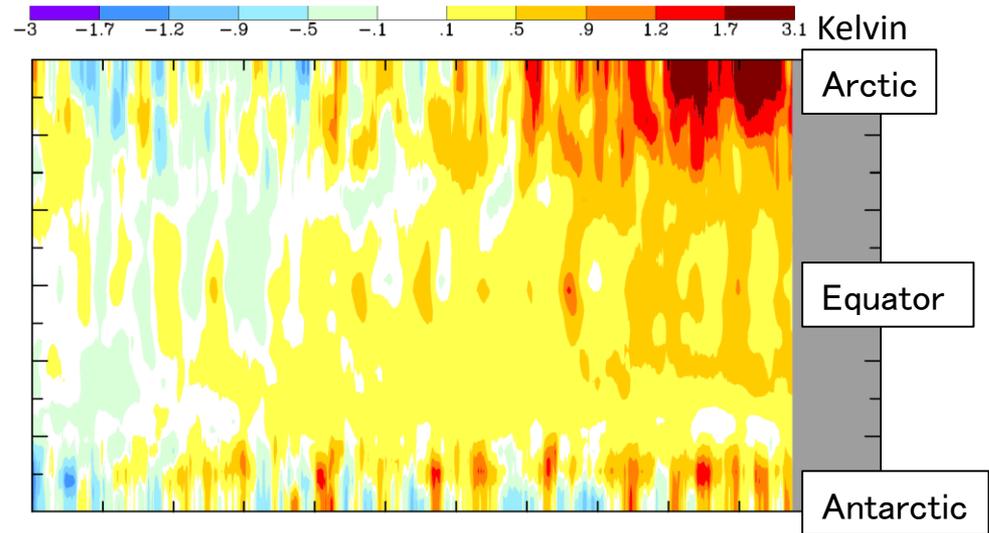
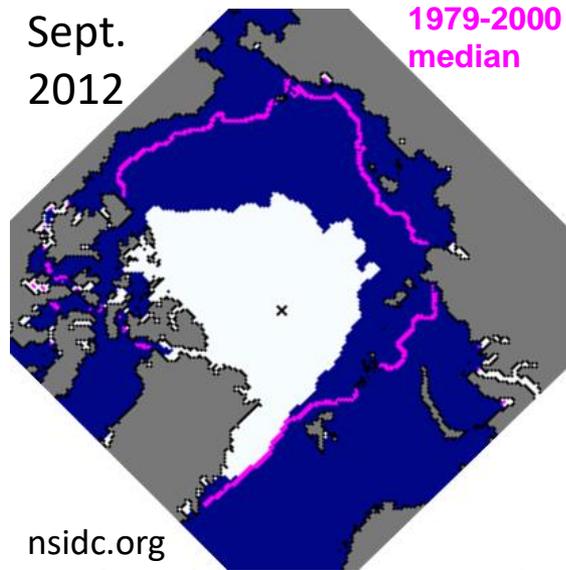
MOSAiC for Arctic Process Understanding

Matthew Shupe (Univ. Colorado/NOAA)

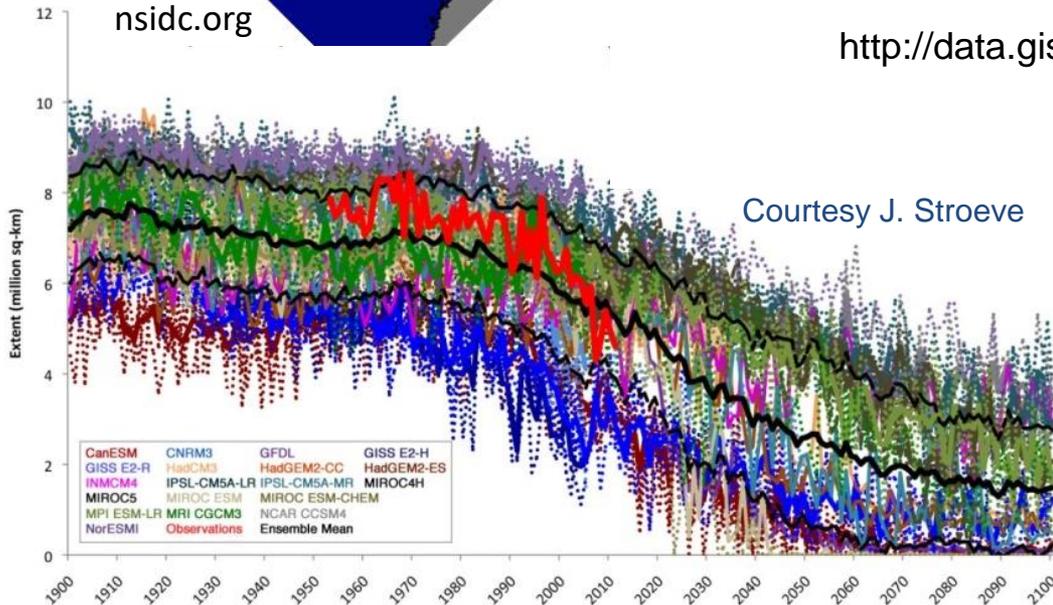
de Boer, Dethloff, Hunke, Maslowski, McComiskey, Persson, Randall, Tjernstrom, Turner, Verlinde



Changing Arctic



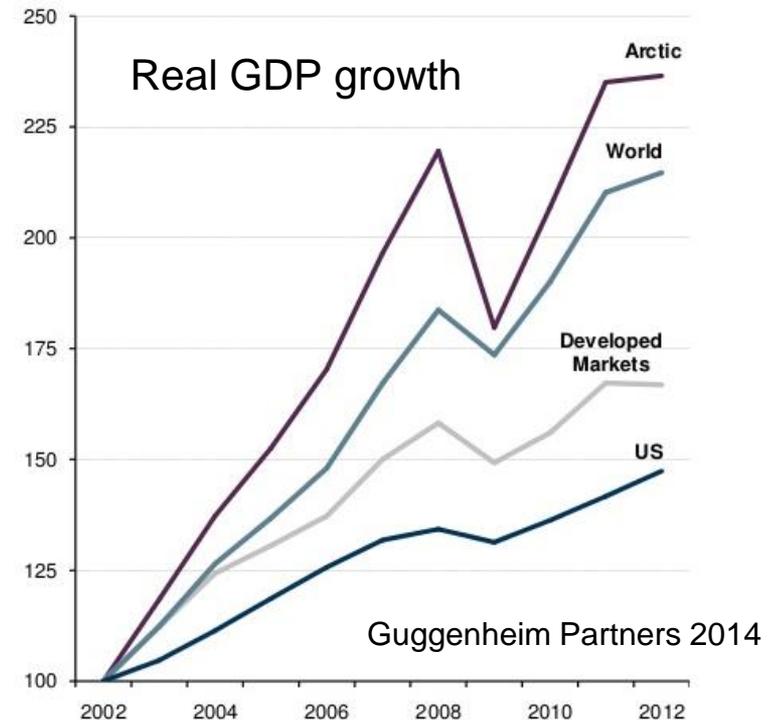
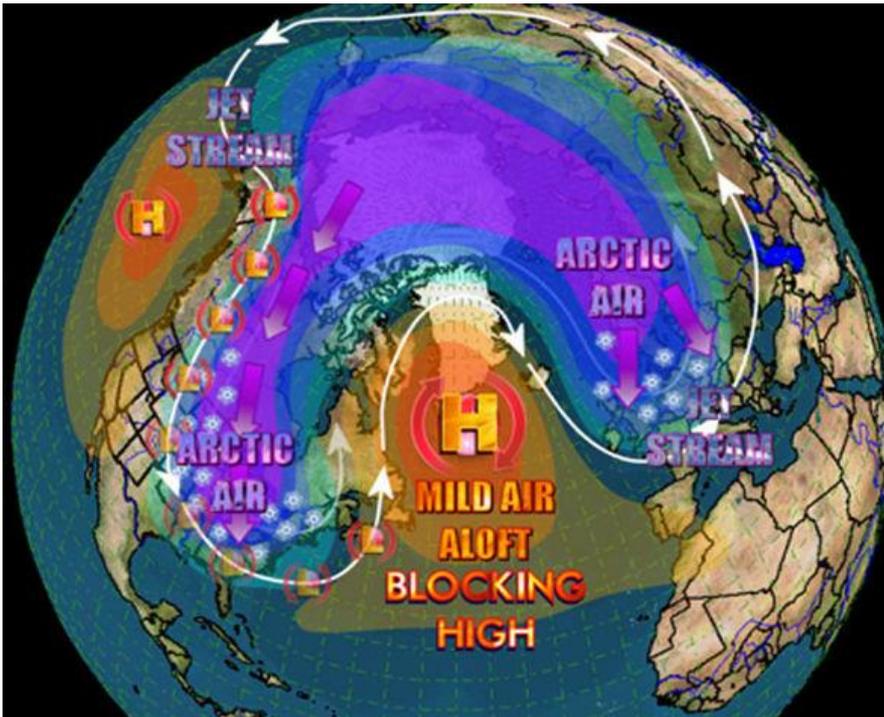
http://data.giss.nasa.gov/gistemp/time_series.html



- Sea ice decline
- Arctic amplification
- Global system links?
- Large model spread
- Challenges representing Arctic system

Why we care

- **Societal Implications:** resource development, shipping, communities, coastlines, fisheries, ecosystems, productivity
- **Forecasting:** Alaska weather, Large-scale linkages, Sea-ice forecasts, YOPP and the international NWP community
- **Climate prediction:** Feedbacks, tipping points



Need for Improved Models

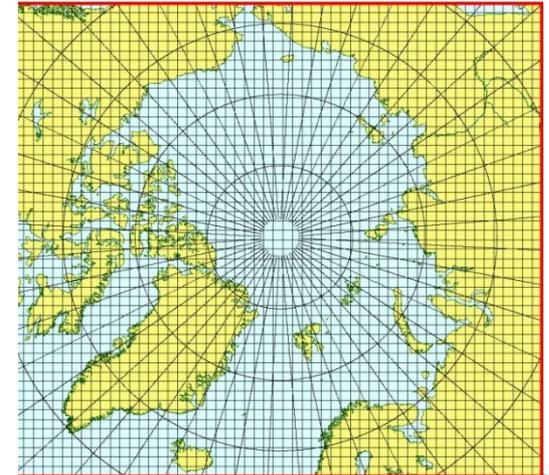
1) Weather; 2) Climate; 3) Sea-ice

All require physical representation of a changing Arctic

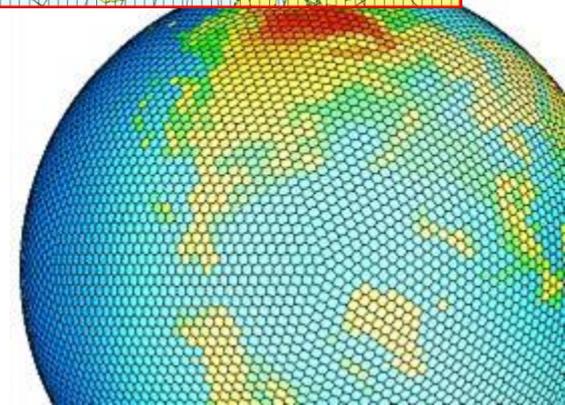
**Conclusions from IPCC, WMO-
WWRP-YOPP, and others**

**Major deficiencies in Arctic:
clouds, boundary layer, winds,
surface fluxes, ocean mixing.**

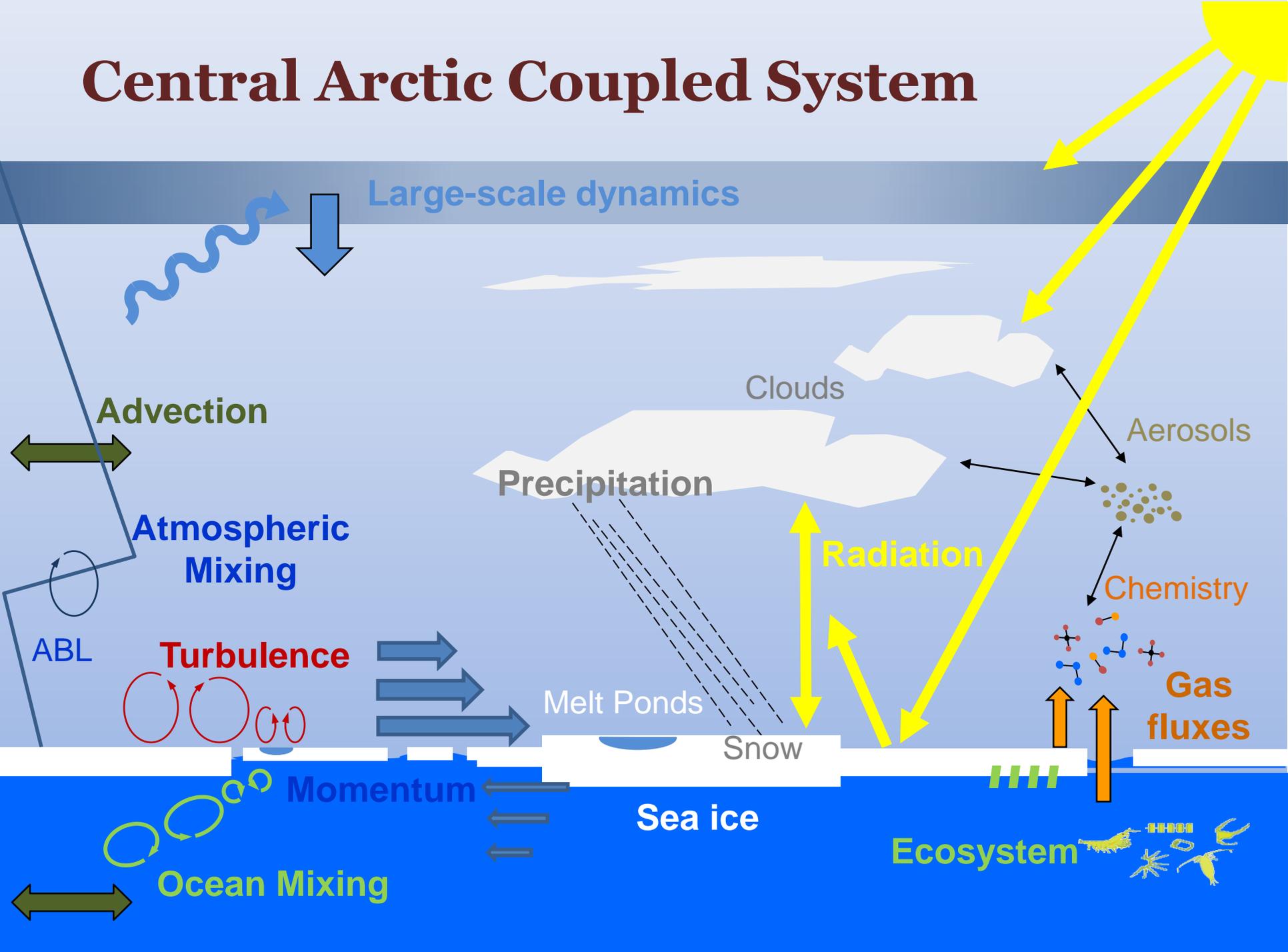
Lack of observational data



*Coupled global models are the new frontier
Need to focus on processes*



Central Arctic Coupled System



MOSAIC Science Drivers



“What are the causes and consequences of an evolving and diminished Arctic sea ice cover?”

Science Thematic Topics

- 1. Sea-ice energy budget**
- 2. Ice movement & deformation**
- 3. Clouds / Precip / Aerosols**
- 4. BioGeoChemistry and Ecosystems**

MOSAiC Science Drivers for ARM



Surface energy budget

- Radiation
- Turbulence

Clouds and Precipitation

- Phase partitioning
- Snowfall
- Spatial structure
- Relation to leads

Aerosols

- Annual cycle properties
- Source attribution
- Cloud impacts

ABL structure

- Momentum transfer
- Coupling
- Moisture sources

A Year in the Arctic



Fall 2019 to Fall 2020

Central Observatory:
RV Polarstern



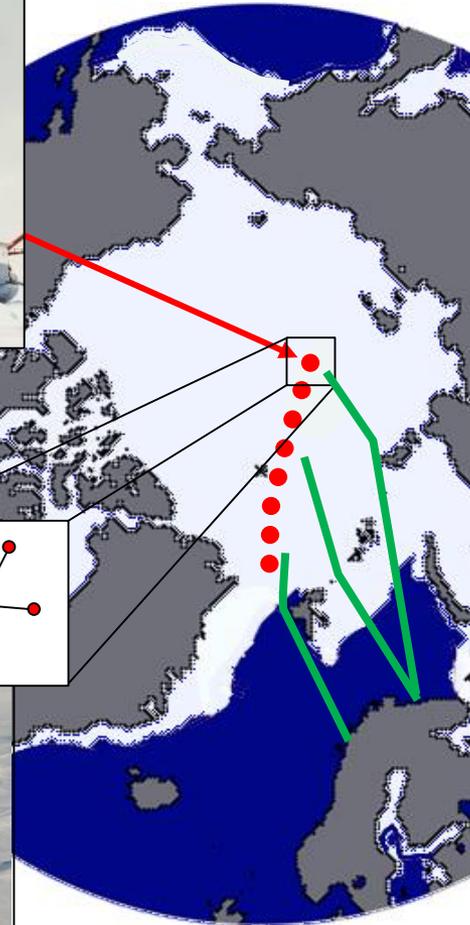
→
Extend vertical &
geographic coverage



Research
aircraft
and vessels



Coupled observations
Atmos-Ice-Ocean-Eco-BGC



Distributed network



Rendezvous with
icebreakers from
MOSAIC partners

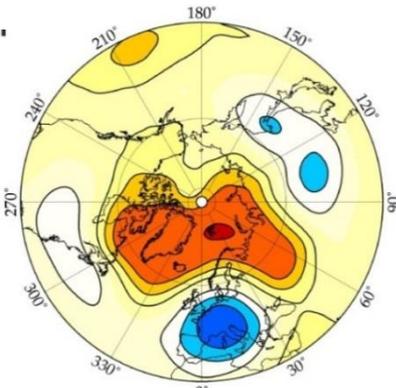
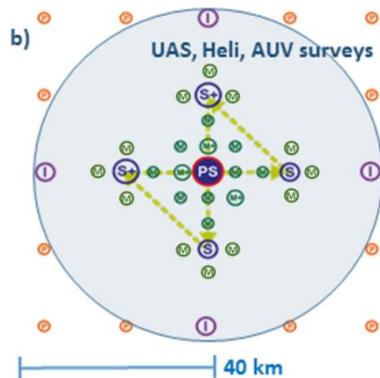


→
Broader geographic
coverage & supply



Autonomous systems,
buoys, UAS, AUV

Multiscale Design



Central Observatory

- Ship/ice based
- Attended observations
- Coupled system processes
- Process models, parameterization

< 5 km

Distributed Network

- Autonomous stations, UAS, AUV
- Drifting “model grid cell”
- Heterogeneity
- Upscaling
- Regional modeling

< 50 km

Large-scale linkages

- Collaborating research vessels and supply cruises
- Aircraft campaigns (Polar 5/6, etc.)
- Arctic station and buoy networks, satellites
- Data assimilation studies
- Arctic regional & global models
- Link with YOPP

> 1000 km

Observations

(a subset)

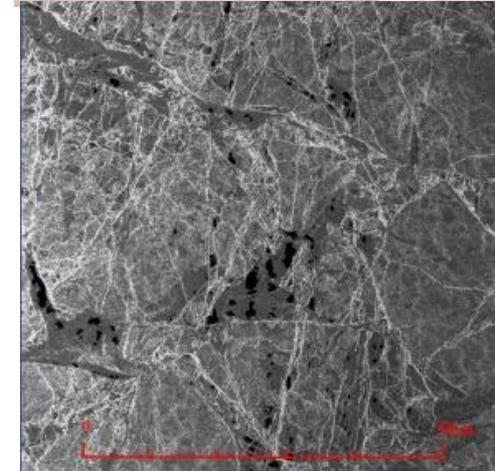


Atmosphere

Vertical structure (T,q,wind)
Clouds/precip
Aerosols/gases
Surface energy budget
Momentum transfer

Ice+Snow

Surface type dist'n
Thickness/depth
Thermodynamics
Radiative properties
Deformation/movement

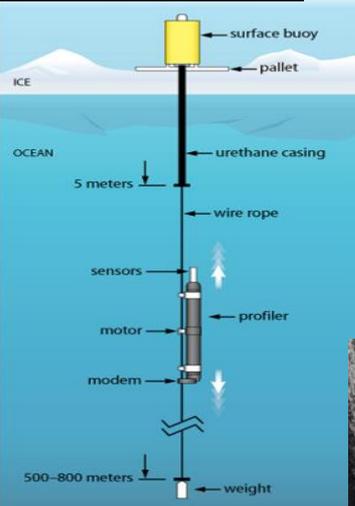


BGC/Ecosystem

N, S, C cycles
Gas fluxes
Bio-optics
Communities
Primary productivity

Ocean

Structure (T,s,currents)
Ocean dynamics
Heat flux
Momentum transfer



Modeling Strategy

Process
Understanding

Validation
Evaluation

Regional

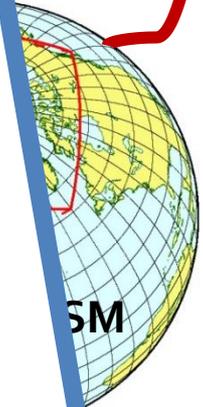
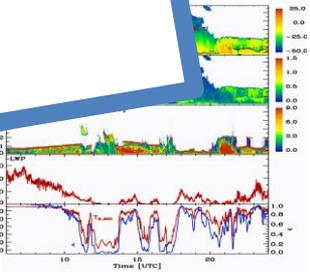
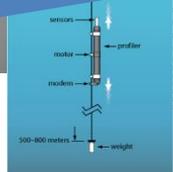
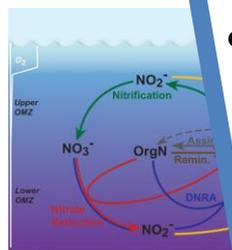
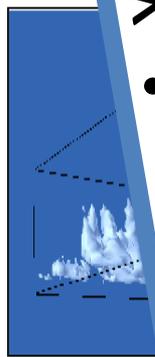
Projections
Ensembles

YOPP

>90 specific modeling activities planned

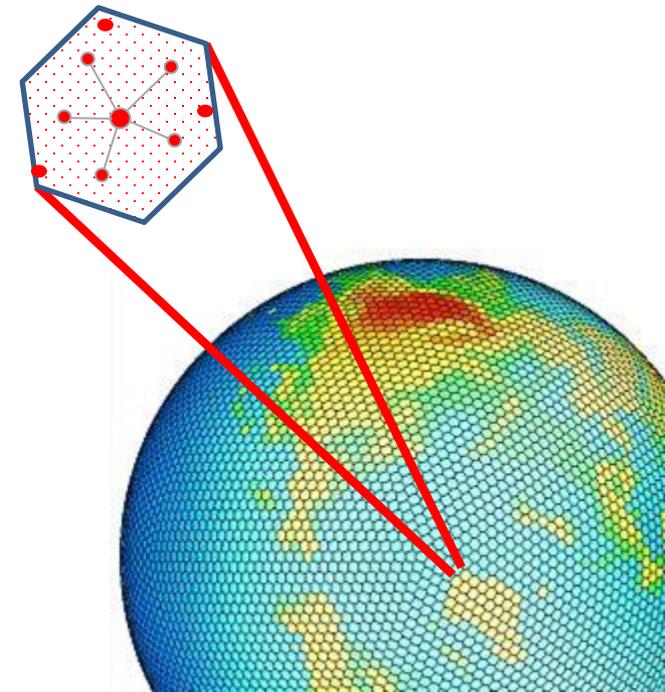
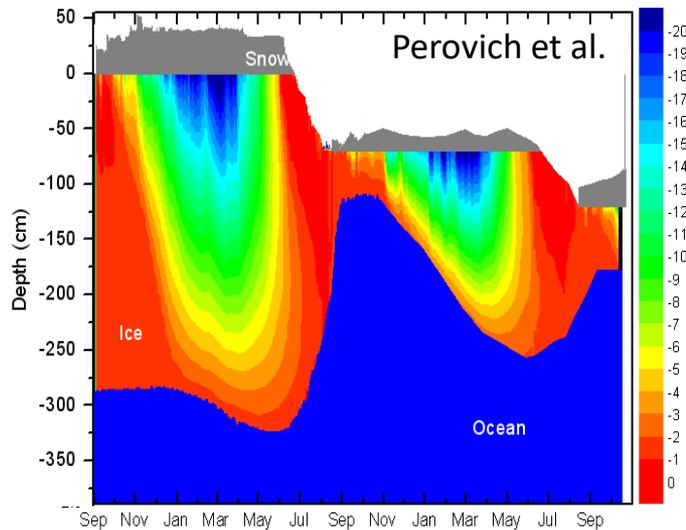
- 1D snow models
- LES cloud modeling
- Coupled Single Column Modeling
- Regional model intercomparison (Arctic CORDEX)
- Fully coupled system forecasts
- Operational regional and global forecasts
- Global cloud-resolving model
- Drift Forecast Experiment / comparison
- Data denial / Assimilation studies
- Parameterization assessment

Expanded observational foundation



A Distinctive Opportunity

- 1) **Fills observing gap:** Most detailed coupled system process observations ever
- 2) **Year round:** seasonally evolving processes, interseasonal linkages, what happens in winter?
- 3) **Heterogeneity:** upscaling for models
- 4) **Highly Leveraged:** aircraft campaigns, other ships, satellite programs, YOPP, etc.



Status

- ✓ White House Ministerial activity
- ✓ Icebreaker committed for 1+ year
- ✓ Major logistics in place
- ✓ Other partner ships
- ✓ ~15 nations involved
- ✓ DOE, NSF, NASA, NOAA (~10 US berths)
- ✓ Integration with YOPP

Science and Implementation Plans



www.mosaic-expedition.org

